

A Newly Discovered Host Association and Descriptions of Immature *Nacaduba berenice leei* Hsu (Lepidoptera: Lycaenidae)

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ABSTRACT

An investigation on the immature biology of butterflies on Orchid Island (*Lanyu* in Chinese), Taiwan was carried out while executing a monitoring program on the effects of exotic, invasive species to this small island. Immatures of *Nacaduba berenice leei*, a recently discovered lycaenid, were found during the investigation. The recognized larval host is *Rourea minor* of the Connaraceae, a plant family previously unknown as a host for populations of *N. berenice* from the other regions.

Key words: Polyommatainae, host plant, Connaraceae

Introduction

There seems to be a tendency for an increase in the successful establishment of exotic species of butterflies in Taiwan (Chiba and Hsu, 2003; Hsu *et al.*, 2003). Although invasive exotic species have been found throughout the island, Orchid Island (*Lanyu* in Chinese), a small tropical island off the southeastern coast of Taiwan, has been a focus of concern. The reason why Orchid I. is of particular interest is due to the fact that the island hosts a diversity of butterflies that greatly differ from that of the main island of Taiwan, including species like *Troides magellanus*, which is considered endangered locally and internationally (Yen and Yang, 2001). As recent cases of

successful establishment on the island by exotic species have been documented (Lu and Hsu, 2002; Hsu *et al.*, 2003), there is concern that the original fauna may be negatively affected by such exotic invasive species. In order to assess the effects that exotic species may cause, it seems crucial to have a better understanding of the biology of the original fauna on Orchid I. A project for monitoring exotic butterflies which have invaded the island was initiated in 2003, and an investigation on gathering biological information is simultaneously being carried out. Findings during the project include the discovery of the immature biology and host association of *Nacaduba berenice leei* Hsu.

Nacaduba berenice leei (Fig. 1.1) is

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one of the most recently described butterflies in Taiwan (Hsu, 1990). Although the species *N. berenice* is widespread throughout Southeast Asia and Australia (Tite, 1963), to the present it has only been found on Orchid I. within Taiwan. The present study confirms the host plant of *N. berenice leei* on Orchid I.; an account on the immatures of this lycaenid is also given.

Materials and Methods

Plants that are potentially utilized by larva of *N. berenice leei* were examined on Orchid I. during the investigation; these included plants in various families, e.g., the Sapindaceae, Sterculiaceae, Fabaceae, and Ulmaceae according to host records from regions other than Orchid I. (Bell, 1918; Common and Waterhouse, 1981; Parsons, 1991, 1999; Kitamura, 1994, 2001; Braby, 2000; Robinson *et al.*, 2001; Herbison-Evans and Crossley, 2003). Collected immatures were brought back to a laboratory on the campus of National Taiwan Normal University, Taipei for subsequent observations. Rearing records adopted the system used by Powell and De Benedictis (1995). Each collection of immatures was labeled according to the collection year and month: e.g., 03F8 refers the eighth collection in June 2003. This system employs alphabetical letters to represent months in sequence.

The terminology for the myrmecophilous organs follows Fiedler (1991).

Results

During the survey, vegetation of *Pometia pinnata* (Sapindaceae), *Cardiospermum halicacabum* (Sapindaceae), *Dendrolobium umbelatum* (Fabaceae), *Derris oblonga* (Fabaceae), *Derris trifoliata* (Fabaceae), *Ormocarpum cochinchinense* (Fabaceae), *Pueraria montana* (Fabaceae), *Sterculia ceramica* (Sterculiaceae), *Celtis*

philippinensis (Ulmaceae), and *Trema orientalis* (Ulmaceae) were examined for the presence of immature *Nacaduba berenice leei*. No sign of immatures of this lycaenid, however, was found from any of above plants after 15 months of investigation. Alternatively, ova and larvae of *N. berenice leei* were found from young shoots of *Rourea minor* (Connaraceae) (Fig. 1.2) and subsequently reared out during the investigation (HSU 03F8; 04H5).

Accounts of immatures of *Nacaduba berenice leei* Hsu, 1990

Ovum (Fig. 1.3): 0.45 ± 0.01 mm in diameter, 0.22 ± 0.01 mm in height ($n = 10$). Mandarin-shaped, pale olive, semi-transparent in color; chorion with white ridges forming network with diamond-shaped pattern laterally and irregular sculpturing on top.

Larva (Figs. 1.4, 1.5)

First instar larva (Fig. 1.4): Body smooth with transparent primary setae, pale olive right after hatching. Head pale brown, glossy, with brown stemmata. Legs and prolegs pale olive. Caudal end of anal plate circular. Body turning green or orange after feeding. Arrangement of primary setae as follows: XD1 and XD2 very short but equally long, barely recognizable. D group unisetose, only elongate, setaceous D2 present on T1 through T3, A1 through A8 all pointed posteriad; well separated on T1 and T2, close to dorsal midline on T1 and A1 through A8. SD and L setae vestigial. SV setae short, transparent, arranged on the same plane throughout body. Three SV setae present on T1 through T3, 2 on A1 through A8. Four SV setae present on A 9 + 10.

Second instar larva: Head green. Coloration of body variable, being pale green, orange, or red.

Third instar larva: Body relatively



Fig. 1. 1. An adult of *Nacaduba berenice leei* taking nectar. 2. Host plant (*Rourea minor*) of *Nacaduba berenice leei* on Orchid I. 3. Ovum of *Nacaduba berenice leei* on a new bud of *Rourea minor*. 4. First instar larva of *Nacaduba berenice leei*. 5. Mature larva of *Nacaduba berenice leei*. 6. Pupa of *Nacaduba berenice leei* in debris.

stout, with a medial depression in thorax dorsally. Body covered with short, transparent setae. Functional DNO and TOs both present. T1 shield ladder-shaped,

weakly sclerotized. Body cream yellow with red markings present laterally and dorsally. Spiracles same color as body.

Fourth (last) instar larva (Fig. 1.5):

Similar to 3rd instar, DNO and TOs both present. T1 shield diamond-shaped, green. Body covered with asteroid setae; setaceous, elongate setae present below spiracles. Coloration of body variable, with ground color ranging from pale green or yellow to pale red. Prominent red markings of variable extent present dorsally and laterally, forming longitudinal line above and below spiracles and mediodorsally. Spiracles cream yellow. Larva reaching 11.04 ± 0.40 mm in length upon maturation ($n = 10$).

Pupa (Fig. 1.6): Of typical lycaenid form. Surface with creases, glossy; color brown tinged with yellow, mottled with dark brown, forming a longitudinal medial band dorsally. Spiracles brown.

Bionomics

The ovum is laid on young growth (Fig. 1.3). The enclosed larva feeds only on soft tissues of the host plant, such as young leaflets or stems. No myrmecophily was observed. Pupation occurs in debris in a cavity (Fig. 1.6).

Vouchers: 3 ♂, 2 ♀, TAIWAN: TAI-DONG Co., Orchid I. (*Lanyu*), Sidaogou, 13/15-VI-2003, Coll. Y. F. Hsu, emgd. 28-VI/4-VII-2003, reared from *Rourea minor*, HSU 03F8; 14 ♂, 12 ♀, TAIWAN: TAIDONG Co., Orchid I., Badaiwan, 6/8-VIII-2004, Coll. Y. F. Hsu, emgd. 17-VIII/23-VIII-2004, reared from *R. minor*, HSU 04H5.

Discussion

The other populations of *N. berenice leei* are found in the Philippines (Takanami and Seki, 2001), where the host plant of *N. berenice leei* is known to be *Nephelium mutabile* [mis-spelt as *mutabili*] (Sapindaceae) (Kitamura, 1994; 2001). Although plants in the Sapindaceae are abundant on Orchid I. (Cheng and Lu, 2000), no immatures of *N. berenice leei* were found from these plants after extensive searching during the

investigation for the present study. Instead, ova and larvae of *N. berenice leei* were found on young growth of *Rourea minor* (Connaraceae), a woody vine widespread in the forests there (Cheng and Lu, 2000; Liu *et al.*, 2001).

An association with the Connaraceae is rare among lycaenid butterflies. In a worldwide analysis on the relationship between lycaenids and families of host plants they utilize, Fiedler (1995) did not even include this plant family. Robinson *et al.*, (2001) recognized only five species that are known to be associated with the Connaraceae in the Oriental region; nevertheless, among them, four are known as polyphagous species, with just *Nothodanis schaeffera* recognized as a specialist. Braby (2000) listed three Australian lycaenid species that are associated with the Connaraceae, but again two of them are general feeders; the other one, viz. *Danis danis*, is a specialist on the Connaraceae and Fabaceae. The only other known Connaraceae specialist is *Nacaduba sericina* from the Philippines (Kitamura, 2001). Thus the Connaraceae association by *N. berenice leei* at Orchid I. represents an unusual host-association among lycaenid butterflies.

So far the distributional range of *N. berenice leei* includes only Orchid I. and the Philippines (Takanami and Seki, 2001). As noted previously, populations of *N. berenice leei* in the Philippines are known to use *N. mutabile* of the Sapindaceae as a host plant (Kitamura, 1994; 2001). Plants in this plant family are extensively utilized as larval hosts by other subspecies of *N. berenice leei* in regions other than Orchid I. and the Philippines. The known host plants of *N. berenice* from other regions include *Alectryon coriaceus*, *Arytera divaricata*, *Ar. foveolata*, *Ar. pauciflora*, *Atalaya salicifolia*, *Cupaniopsis anacardioides*, *C. parvifolia*, *Elattostachys microcarpa*, *E. nervosa*, *Heterodendrum diversifolium*,

and *Jagera pseudorhus* of the Sapindaceae; *Macadamia tetraphylla* and *M. integrifolia* of the Proteaceae; and *Aphananthe philippinensis* of the Ulmaceae in Australia (Common and Waterhouse, 1981; Herbison-Evans and Crossley, 2003); *Calliandra surinamensis* of the subfamily Mimosoideae in the Fabaceae and *Theobroma cacao* of the Sterculiaceae in New Guinea (Parsons, 1991; 1999); and *Wagatea spicata* (Fabaceae) in India (Bell, 1918). It is interesting that although several plant genera of the Sapindaceae, Sterculiaceae, and Fabaceae grow on Orchid I. (Cheng and Lu, 2000), none was found to be a host plant of *N. berenice leei* after extensive field investigations. Consequently the population of *N. berenice leei* on Orchid I. is the first known population of the species that specializes on the plant family Connaraceae. Moreover, the *N. berenice leei* population on Orchid I. is known to be the northeastern limit of the distributional range of the species (Hsu, 1990). Some species of Taiwanese butterflies that represent peripheral populations in overall geographic distributions of those species are known to demonstrate mono/oligophagy in contrast to the polyphagy of the core populations. For instance, the only reliable host record of *Eurema alitha* in Taiwan is *Galactia tenuiloba* of the Fabaceae (Hsu, 2001), whereas this pierid butterfly demonstrates extensive polyphagy in the Philippines (Kitamura, 1996). The Connaraceae association by *N. berenice leei* on Orchid I. may be another representative of such a phenomenon.

Acknowledgments

We thank Shen-Horn Yen (National Sun Yat-Sen University, Kaohsiung) for providing literature relevant to the study. Hang-Chi Huang and Yu-Cheng Hsu (the Butterfly Conservation Society of Taiwan, Taipei) assisted with the fieldwork. This

work was supported by a Council of Agriculture grant 92AS-1.8.1-BQ-BB.

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Received: September 7, 2004

Accepted: May 31, 2005

新發現之熱帶娜波灰蝶寄主植物及幼期形態 (鱗翅目：灰蝶科)

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摘 要

熱帶娜波灰蝶 (*Nacaduba berenice leei* Hsu) 又稱為熱帶波紋小灰蝶，係一近年才從蘭嶼發現的物種，過去尚未有關於台灣地區的該種熱帶性蝶種之幼期形態及寄主植物資料。在 2003 年及 2004 年於蘭嶼調查期間發現熱帶娜波灰蝶在蘭嶼的寄主植物是牛栓藤科的紅葉藤，該植物是熱帶娜波灰蝶族群其他分布地區未曾記錄的寄主植物。

關鍵詞：藍灰蝶亞科、寄主植物、牛栓藤科。